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# Non-Linear Effects of Fiscal Policy on Economic Growth: Moroccan Case

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## Abstract

In the economic theory, many arguments were advanced to justify the efficiency of the fiscal policy with a view to stabilization. For some, expansionist fiscal policies can have favorable effects on the economic growth, while for others, the economy is always in a global balanced situation, and thus the fiscal policy will have no effect and can be even harmful for the economy. However, these two effects can coexist in the economy, therefore putting forward the nonlinear character of fiscal policy in the economy growth.

This study has the objective of appreciating the nature of the relation between fiscal policy and the economic growth in a 36 developing country sample of, taking into account the existence of possible nonlinear effects of the fiscal policy. Due to the use of the methodology of endogenous thresholds, the iterative procedure for the determination of endogenous thresholds developed by Hansen (1996, 1999, 2000) has allowed us to identify an optimal budget deficit threshold of 5.1%, which makes the relation between budget deficit and growth become non-linear. In other words, below this threshold expansionist policies have favorable effects on the economic growth, while above these policies it becomes non-favorable.

Keywords: economic growth, Keynesian regime, Threshold effects, Fiscal policy.

Classification-JEL: E62, H62.

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## **1- Introduction**

For ages, the instruments of the economic policy constitute the economists' principal objective. The question of the effectiveness of the fiscal policy as a key instrument of the economy has become more and more prominent worldwide in the scientific research. The question about this instrument role in the support of the economic growth is highly discussed and gives place to a debate between the Keynesian and their adversaries.

In this context, the economic theory is divided between the Keynesian approach and the neo-classical approach. According to the first approach, the fiscal policy can stimulate the aggregate demand and revive the economy. Whereas the second one suggests that the expansionary fiscal policy has no positive effect on the economic activity. To illustrate, the balance deficits lead to increase the interest rates. Thus, according to the theory of rational expectations, agents make expectations about the taxes they have to pay in the future, resulting in a decline in private demand and supply and consequently a slowdown in activity.

Recent theories of endogenous growth consider that discretionary fiscal policy is effective in terms of GDP, since it stimulates the economic growth. This in turn induces an increase in government revenue and therefore public expenditures<sup>1</sup>. Monetarists state that the fiscal policy can generate a crowding out effect, taking into account that the quantity of money has real effects in the short term on GDP and job marketing because of the prices' rigidity<sup>2</sup>.

This ambiguity between the counter-cyclical activism and the respect of the strict financial orthodoxy has made several economists investigate the nature of the relationship that can exist between economic growth and fiscal policy; (Adam and Bevan, 2005; Bertola and Drazen, 1993; Sutherland, 1997; Tanimoune Ary et al., 2005; Pommier, 2004) based on a study conducted within 45 developing countries, the first authors have shown that there is a non-linear relationship between the deficit and economic growth. They have also estimated that a deficit of 1.5% of GDP corresponds to a threshold level, in which the expansionary fiscal policy is performing whenever it is below the threshold level. Otherwise this policy becomes recessive in different cases.

Concerning the second case, the non-linearity of the fiscal policy that is obtained from the psychological threshold of the public debt was estimated at 83% by (Ary Tanimoune and al (2005)) for the countries of UEMOA. Giavazzi and al (2000) came up with a significant non-linearity relation between the budget balance and public savings. On the contrary, the works conducted on the countries of OCDE by Alésina and al (2002) rejected statistically the hypothesis of the non-linear relation between the fiscal shocks and private investment.

Due to the last financial crisis, the budget deficit and the public debt increased and induced to think about new fiscal disciplines to adapt. Accordingly on the 2 March 2012, twenty-five countries from the European Union signed a new agreement. This latter makes the

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<sup>1</sup> : Anderson et Jordan (1968) ; Barro (1974).

<sup>2</sup> : Wagner (1890), Friedman and Meiselman (1963). These authors attempted to justify the inefficiency of public spending to increase economic growth.

constraints more strict, one of these constraints namely << Golden Fiscal rule>> limited the structural public deficit to 0.5% of GDP.

Recently, the economic growth is a worldwide topic that has concerned particularly African countries. Several studies have claimed that these countries need approximately to reach 7% of GDP yearly in order to reduce the level of poverty by 2015<sup>3</sup>. Morocco is still worried about the economic growth goal, since its agricultural sector is strongly related to climatic hazards and its industry has been weakened by the economic crisis. More precisely, the Moroccan budget deficit reached 7.1% of GDP in 2012, whilst 6.2%<sup>4</sup> in 2011.

Generally, it is admitted that a high rate of fiscal deficit represents a real tax especially for the poor countries. In such a situation, it is important to wonder about the optimal threshold of the budget deficit in order to boost the economic growth?

In other words, is there any optimal deficit rate below which every fiscal policy has positive effects on economic activities? These questions highlight the non-linear nature of the relation between deficit and the economic activity.

This necessity to take into consideration the non-linearity, which is one of the main characteristics of the macroeconomic series, led to adopting models for regime change, specially the model (PTR5) which has the advantages of providing an economic explanation of the non-linear?. This models class was pioneered originally by Tong (1978) and Tong Lin (1980). Their priorities allow to an economic series to have different steps of evolution related to the regimes or the states of the world in where it occurs.

The first section of this study is going to provide a brief review about the fiscal – growth policy. The second section is going to expose the mode to determine threshold of the optimal fiscal deficit. Finally, in the third section we are going to discuss over the results as well as their implications in term of economic policies.

## **2-The Literature Review:**

The analyses of the behavior of the fiscal policy can lead to several outcomes, particularly the evolution of the budget variables such as the budget deficit and the economic growth, which can lead to a transition from a regime to another. This can be carried out according to an observable variable transition, of a threshold. According to this latter, the fiscal policy could be Keynesian (countercyclical), not Keynesian and anti-Keynesian (procyclical). The advent of these three effects of fiscal action could be the consequence of the difficulty experienced by the state to arbitrate between the counter-cyclical activism and the respect for the major macroeconomic balances.

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<sup>3</sup> : Report OMD 2012 « Évaluation des progrès accomplis en Afrique dans la réalisation des objectifs du Millénaire pour le développement », PNUD, 2012.

<sup>4</sup> : Moroccan Ministry for the economics and finances.

<sup>5</sup> : Panel Threshold Regression

## **2-1 Expansionary effects of budget deficits:**

According to the traditional Keynesian approach, a fiscal deficit can be a stimulator for the economic activity, especially in period of recession. It suggests that the state can increase deficits in certain circumstances, provided that fiscal policy remains practicable. However, this theory doesn't define plainly a desirable and optimal debt ratio. For this approach, the variation in public spending can have an effect on the behavior of economic agents, assuming that the best way to regulate the growth resides in adopting counter cyclical fiscal policies.

(Lau, 1999) observed the previous experiments conducted in the eighties, by some northern European countries. In these economies, the reduction of the public spending was considerably enormous, swift and sustainable (at least for three years), which has conducted to an extensive effect on the domestic activity.

(Givazzi and Alii, 2000) indicates that the action of fiscal consolidation by the contraction of the expenditure would be preferable to the extent that a tax increase poses a problem of inter temporal credibility. Besides, it creates significant supply through distortionary tax levies.

Alesina and Ardangna (1998) checked all the episodes of fiscal adjustment undertaken by the OECD countries since 1960. They have showed that the adjustments, which have succeeded and had an expansionary effect are those that targeted the reduction in public spending. Nevertheless, the adjustments that dealt with tax increase do not have such a high probability of success. The decisive factor for this result seems to be the composition of adjustment rather than its size.

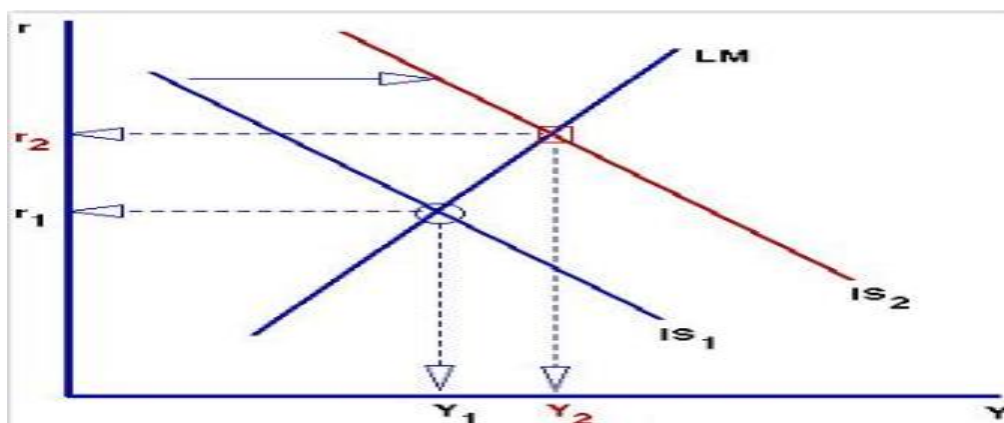
Baldacci and al (2003) estimate that fiscal adjustment, which reduces unproductive expenditure and preserve the public investment is more sustainable and likely to accelerate the growth. In general, budget adjustment an effective on the expenditures allocation for a lucrative purpose, which will lead mainly to the acceleration of the economic growth, in essence, in countries where the macro-economic situation is unfavorable.

## **2-2 Neutrality of the public deficits:**

Inspired by Ricardo, BARRO (1974) took part in rebutting the effectiveness of fiscal policy due to the principle of Ricardian equivalence, since, for him the private agents include, in their calculation the inter temporal budget constraint of the state. In this way, the new classical school states that the current reduction in public spending, the states creates conditions of lower tax collection rates in the future and vice versa in case of an increase in expenditure.

Anticipated by agents, the budgetary policy will have no effects. There noted in this case, an increase in private savings while public savings bend, the expansionary fiscal policy will have no effects on the economy. This situation could be represented graphically as follows:

Chart1: Ricardian equivalence through the IS-LM model:



the expansionary fiscal policy shifts the curve  $IS_1$  to  $IS_2$ , which has the effect of increasing the income of  $Y_1$  to  $Y_2$ . If this policy is financed by borrowing, the state will later collect taxes to pay off the debt. Instead of increasing consumption, the rational agents will save much more which leads  $IS_1$  to  $IS_2$ .

### **2-3 Restrictive effects of public deficits:**

Several authors renewed the reflection on the effects of fiscal policy on the economic growth. They suggested that the fiscal contraction could even have a positive effect on economic activity. They started from the idea governments use fiscal policy inappropriately, especially for electoral purposes and not for regulatory purposes (J  rome Ceel et al. 2005).

Moreover, a high level of budget deficit, leads to excessive accumulation of public debt. Their hypothesis was based on the observation of experiences in the 80s within several Northern European countries. This is indeed the stone – corner of the New Anti-Keynesian theory of public finance (or TAK NAK). This latter is now widespread in the European area (Guide et al 2003).

The fiscal consolidation, which refers to the reduction of the fiscal deficit gotten from the reduction of the expenditures, has a favorable effect on the level economic activity. In this context, Ondo Ossa (2005) showed in a study on CEMAC<sup>6</sup> that a decline in public spending led to the elimination of expansionary bias of fiscal policies.

### **2-4 Nonlinear effects of public deficits :**

The last works on the effects of the fiscal policy and the economic growth admit the coexistence of three different between the behaviors in economic activities namely: Keynesian, non-Keynesian and anti-Keynesian. These studies suggested that the economy may be Keynesian in a normal period, and non-Keynesian or anti-Keynesian in some other deficit circumstances. The major adjustments in particular would be more likely to attract non-

<sup>6</sup> : The Central African Economic and Monetary Community (CEMAC) is made up of six States: Gabon, Cameroon, the Central African Republic (CAR), Chad, the Republic of the Congo and Equatorial Guinea.

Keynesian behaviors, because these ones interfere generally in critical periods where agents' behaviors change.

Works such as (Blanchard 1990, Alesina and Perotti 1995, Perotti 1996), which confirm that budgetary adjustments, in a normal period, lead to an increase of incomes. Whereas an often decrease of expenses during the tough periods.

However, these models cannot take into consideration the expansionary effects of a deficit progress: they can lead to a non-Keynesian or an anti-Keynesian behavior, but never to a Keynesian behavior.

The second category of models (Keynesian models with a threshold effect) relies on non-linearity which is shown by Bertola and Drazen (1993) in their article in which they state that this non-linearity may be the result of a psychological threshold of indebtedness. Since the agents are confident that the public debt remains sustainable; they can ignore the consequences of Bertola and Drazen showed in a sample of 45 developing countries, that there is a non-linearity relation between the budgetary deficit and the economic growth. They estimated that a deficit of 1.5% of the GDP corresponds to a threshold below which the Keynesian fiscal policy has expansionary effects on the activity, and above which the policies will have negative effects.

The article of Caballero and Pyndick (1996) suggest that in a “critical” budgetary situation, the agents are non-Keynesian and the macro-economic uncertainty inherent to the non-solvency of public finances encourages them to make a precautionary savings or to delay investments generating irrecoverable costs in response to a new deterioration of public finances.

Sutherland (1997) introduces an uncertainty towards the intergenerational distribution of future taxes. In his model made with overlapping generations and in which consumers reason with a limited lifetime. the agents behave in a Keynesian way while the public debt is low and still they think that the burden adjustment should be supported by the future generations; they become anti-Keynesian as the probability of supporting this burden by themselves increases. In other words, the agents are non-Keynesian in a critical budgetary situation.

Ary Tanimoune, Combes and Plane (2005) have used the method developed by Hansen (1999) in the zone UEMOA<sup>7</sup>. They have estimated that with a debt ratio below 83% of the GDP, the government exercises a Keynesian influence on the economic activity, and non-Keynesian, or anti-Keynesian in the opposite situation.

Based on a sample of developed countries and others, Sarel (1996)<sup>8</sup> noticed that when the process of development is below the threshold of 8% of the GDP, then the inflation has a positive effect on the economic growth. When it is below the threshold, it has a negative effect.

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<sup>7</sup> : The West African Economic and Monetary Union is made up of eight States: Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo.

<sup>8</sup>: SAREL, M. (1996), « Nonlinear Effects of Inflation on Economic Growth», IMF Staff Papers, March 1996, pp. 199–215.

Drukker and al (2005) made a study on a sample of 138 countries over the period between 1950 and 2000 in which they relied on the detection's technique of the threshold level developed by Hansen (1999) that targeted the dynamic models of panel. They found that the inflation exercises a non-linearity effect on the economic growth. Consequently, when the inflation exceeded a threshold of 19.6% of the GDP, then economic growth decreases.

Based on the annual data over the period 1978-2005 made on 19 OCDE countries, Minea and Villieu (2008) found out that the budget deficit exercises the non-linear effects exerted by the public deficit on the economic growth. The public debt ratio showed that the budgetary deficit has a negative effect on the economic growth when the public debt is very high, but a positive effect when it is not. The estimation of this model helped to find a public debt threshold around a rate of 90% that will cause a change of sign in the relation between deficit and economic growth. According to the public debt's rate which showed that the budget deficit had negative effect on the economic growth when the public debt is very high, but a positive effect when it is not. Its debt's burden reduces the positive impact of the deficit on the economic growth whilst its impact becomes negative when this debt is very high.

Based on a study made on 44 countries by Reinhart and Rogoff (2010) where they discovered that there is a non-linear relationship between the economic growth and public debt. This later represents less than 90% of the GDP when the relationship between public debt and the rate of the economic growth is low. On the one hand, the rate discussed above is relatively constant and may increase to around 3-4% of GDP. In the other hand, when the public debt rate exceeds 90%. The rate of the median growth decreases to about 1%, still the average growth reduces in a very profound way under the same sort of conditions, which makes it become probably negative<sup>9</sup>.

Based on a study conducted within several countries over the period of 40 years, Kumar and Woo (2010) investigated the relationship's nature between the public debt and economic growth. The empirical results shows an opposite relationship between them. Whenever the debt's rate increases to 10% of the GDP, the GDP growth decreases yearly to around 0.2%. In short, the non-linearity becomes highly noticeable when the debt's rate surpasses significant levels leading to negative effects on the economic growth.

As shown in a study conducted by Baum and Rother (2012) within 12 countries from the period between 1990 to 2010, they found out that the debt's impact on the GDP growth is positive and significant; however, this impact will drop up 0 when the debt's rate surpasses

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<sup>9</sup>: See (Thomas Herndon, Michael Ash and Robert Pollin (2013)): they sought to replicate the results of Reinhart and Rogoff using data directly from them. They detect three significant errors in the processing of data performed by Reinhart and Rogoff, now these methodological flaws particularly influence the results. First, Reinhart and Rogoff have omitted some years where economies knew both high growth rates and high public debt. In this case, they do not take into account the economic performance of Australia, New Zealand and Canada in the immediate postwar period. Then they used an unconventional method to weight the countries when they aggregate their data, reducing the final average growth rate of indebted economies. Finally, Reinhart and Rogoff simply have not selected all their data to Excel, which ultimately led them to exclude from scanning five countries were characterized by both a high level of public debt and a high rate of average growth.



67%. In brief, whenever this rate exceeds 95% of the GDP; the debt's rate would definitely have a negative impact on the economic growth.

Relied on a quarterly data from 2000 to 2012, Nana Kwame a kosah (2013) used the VECM<sup>10</sup> model to examine the effect of the fiscal deficit threshold on the economic growth in Ghana. This study reveals the existence of an inverse relation between the fiscal deficit and economic growth. Whenever the deficit is high, the economic growth falls. The author determined the fiscal deficit threshold at 4% of GDP. Above the threshold, the deficit could be detrimental to the economic growth but below this threshold; it could stimulate the economic growth. Basically, we need to determine an optimal level of the deficit. In short, the expansionary fiscal policy has a negative effect on economic growth above 4% of GDP while this latter promotes the economic growth below this threshold.

## **II -Threshold effects of fiscal deficit: Economic tests in a threshold panel model:**

Conditionally to a threshold, the economic activity of a country may contain several fiscal regimes. This threshold linked to the level of fiscal deficit, debt, inflation, savings, etc. The threshold mentioned above is the point of the non-linearity between the variables studied. This assesses the effect of this non-linear effect possible. Most importantly, Bruce Hansen (1996, 1999, and 2000) developed a method equipped to calculate the threshold. Overall, this model will be presented as follows: First, we will discuss the specification of the model, then the estimation of the targeted model.

### **II-1 Model specification and Estimation:**

Firstly, the principal idea of the study is to evaluate the impact of the fiscal policy on economic growth, conditionally to the fiscal deficit threshold's level. The activity captured by the economic growth (EG) in the total investment has a prominent role in this study. To illustrate, it has been chosen as a fiscal variable; still the threshold variable in this model is represented as the rate of the fiscal deficit (FD):

$$EG_{it} = \alpha_i + \beta X + \delta INV_{it} * I(BB_{it} \leq \gamma) + \theta INV_{it} * I(BB_{it} > \gamma) + \varepsilon_{it} \quad (1)$$

I(.) it refers to an indicator function that takes the value 1 if the condition between brackets is been, respected and zero If is not:

This equation can also be written

$$EG_{it} = \alpha_i + \beta X + \delta INV_{it} + \varepsilon_{it} \quad si \ BB_{it} \leq \gamma \quad (2)$$

$$EG_{it} = \alpha_i + \beta X + \theta INV_{it} + \varepsilon_{it} \quad si \ BB_{it} > \gamma \quad (3)$$

The index i (i=1...N) refers to developing countries, while the index t (t=1...T) denotes the period of observation.  $\alpha_i$  indicates countries' specific effects which is simultaneously considered as fixed effects. This restrictive hypothesis refers to the fact that the unobservable

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<sup>10</sup> : Vector error correction model.

heterogeneity between countries is an additive character.  $\varepsilon_{it}$  denotes a white noise which is independently and identically distributed with zero average as well as constant variance.

The vector X contains several economic policy variables and specifications. This latter highlights two regimes: in the first regime, the rate of fiscal balance is lower than the threshold. This regime is known as normal  $BB_{it} \leq \gamma$ , still the rate in the second one (critical)  $BB_{it} > \gamma$  exceeds the threshold  $\gamma$ .

According to the Keynesian regime, the impact of the investment on the economic growth is assumed being positive in normal regime ( $\delta > 0$ ). In contrast, the effect of the investment in the non-Keynesian regime may be zero ( $\theta = 0$ ) or negative ( $\theta < 0$ ).

## **II-2 The steps for estimating a threshold panel model:**

The estimation of a threshold model requires the determination of the optimum threshold, and then tests the linearity of the process.

### **II-2-1 Determination of the optimum threshold:**

The first step is to determine the optimal threshold value  $\gamma$ . Hansen (1996-1999) proposed the removal of the individual fixed effects, via the elimination of the permanent differences between individuals over the period and that could bias the estimation. The elimination of the individual effects depends on the removal specific individual averages. This stage is standard in linear models (transformation within); however, it requires a careful treatment concerning the study of threshold models. This new difficulty occurs because the individual effects rely on the threshold; therefore, it should be recalculated in every research's iteration of the latter. In other words, we will subtract from each variable an average per each individual:

$$\widetilde{EG}_{it} = \beta \widetilde{X} + \delta \widetilde{INV}_{it} * I(BB_{it} \leq \gamma) + \theta \widetilde{INV}_{it} * I(BB_{it} > \gamma) + \widetilde{\varepsilon}_{it} \quad (4)$$

Avec

$$\widetilde{EG}_{it} = EG_{it} - \overline{EG}_l \quad \text{and} \quad \overline{EG}_l = \frac{1}{T} \sum_{t=1}^T EG_{it} \quad (5)$$

$$\widetilde{X} = X_{it} - \overline{X}_l \quad \text{and} \quad \overline{X}_l = \frac{1}{T} \sum_{t=1}^T X_{it} \quad (6)$$

$$\widetilde{INV}_{it}(\gamma) = INV_{it}(\gamma) - \overline{INV}_l \quad \text{et} \quad \overline{INV}_l(\gamma) = \frac{1}{T} \sum_{t=1}^T INV_{it}(\gamma) \quad (7)$$

$$\widetilde{\varepsilon}_{it} = \varepsilon_{it} - \overline{\varepsilon}_l \quad \text{and} \quad \overline{\varepsilon}_l = \frac{1}{T} \sum_{t=1}^T \varepsilon_{it} \quad (8)$$

After eliminating the fixed effects, it is necessary to determine the level of optimum threshold. We estimate the equation (1) by ordinary least squares and for all possible values of  $\gamma$ . Then, determine the residual vector  $\hat{\varepsilon}(\gamma)$  and the sum of squared residuals  $S_1$ . Hansen shows that  $\gamma$  can vary from 1% to 100%, but by removing 10% of the extreme from values we retained a 0, 25%, what gives 320 quintiles.

$$S_1(\gamma) = [\hat{\varepsilon}(\gamma)]'[\hat{\varepsilon}(\gamma)] \quad (9)$$

Chan (1993) and Hansen (1999) recommend minimizing the sum of squared residuals using least squared residuals. The optimal threshold will be the one that will minimize the sum of squared residuals such as:

$$\hat{\gamma} = \underset{\gamma}{\operatorname{argmin}} S_1(\gamma) \quad (10)$$

- Once the value  $\hat{\gamma}$  is obtained, then we can determine the slope coefficients and the vector of residuals that will permit to calculate the residual variance  $\hat{\sigma}^2$

$$\hat{\sigma}^2 = \frac{1}{N(T-1)} [\hat{\varepsilon}(\gamma)]'[\hat{\varepsilon}(\gamma)] = \frac{1}{N(T-1)} S_1(\hat{\gamma}) \quad (11)$$

After the determination of both: the threshold and variance, we can apply the linearity test.

#### 1- The tests of the Linearity and confidence level threshold

The second step is to test the hypotheses of linearity and non-linearity which are presented as follows:

$$\left\{ \begin{array}{l} H_0: \delta = \theta \\ H_1: \delta \neq \theta \end{array} \right.$$

The statistics used by Hansen:

$$F_1 = \frac{S_0 + S_1}{\hat{\sigma}^2} \quad (12)$$

Where  $S_0$  represents the sum of the squared residuals under  $H_0$ . In the meantime,  $S_1$  introduces the sum of squared residuals under  $H_1$ .

This statistic is considered as a classic test in the econometric literature, but it does not follow, however, a standard distribution; and critical values of Chi-deux's distribution which is no longer appropriate. Indeed, the threshold cannot be identified under the null hypothesis; this difficulty is known as "problem of Davies" in the econometric literature (see Davies 1977 1987).

This problem can be solved through the adoption of the methodology of Hansen (1996). We need to simulate the asymptotic distribution of the likelihood ratio test to determine the p-value of statistics through the bootstrap approach.

However, we can generate this p-value using the distribution function (Hansen 2000):

$$P - value = 1 - \left[ 1 - \exp\left(-\frac{1}{2}F_1\right) \right]^2 \quad (13)$$

The solution as follows: if the p-value of  $F_1$  is inferior to the chosen critical value (1%, 5% or 10%), then we reject the null hypothesis of linearity.

Hansen (1999) proposed to construct a confidence's interval based on the maximum likelihood rate which calculated for any  $\gamma$  in order to establish a range of "non-rejection" of the significance threshold:

$$LR_1(\gamma) = \frac{S_1(\gamma) + S_1(\hat{\gamma})}{\hat{\sigma}^2} \quad (14)$$

This statistic is different from the previous (13) because here for  $LR_1(\gamma_0)$  we test the hypothesis  $H_0: \gamma = \gamma_0$  with  $\gamma_0$  which is the true value of  $\gamma$ . Similarly, for the threshold value of the identified endogenous  $\hat{\gamma}$ , the rate of the maximum likelihood  $LR_1(\hat{\gamma})$  is equal to zero and goes to a random variable  $\xi$  which is the distribution function:

$$P(\xi \leq x) = \left(1 - e^{-\frac{x}{2}}\right)^2 \quad (15)$$

The reversal of this distribution allows deriving the expression:

$$C(\alpha) = -2 \log(1 - \sqrt{1 - \alpha}) \quad (16)$$

This expression is necessary to build the interval of the confidence, corresponding to the risk of  $\alpha\%$  to all values of  $\gamma$  such as:

$$LR_1(\gamma) \leq C \quad (17)$$

### **III- Data**

This paper discusses threshold analysis into a standard growth equation to test for a non-linearity relationship between the fiscal balance and long-run economic growth. As established in the growth literature (Barro and Sala-i-Martin, 1995; Levin and Renelt, 1992), real GDP growth is modeled as a function of fiscal balance and control variables. This set of controls includes the rate of general government final conception expenditure (SGC), the rate of total investment to GDP (INV), the average inflation rate (INF), the openness to trade (as defined by the sum of exports and imports to GDP (CC)), the rate of cross-national savings (GNS) and finally the rate of total public debt (GD). Overall, those variables are expressed in current price as a percentage of GDP nominal.

The level of GDP controls the convergence effect noted in the Solow-Swan model (Solow, 1956; Swan 1956). Total investment captures the positive effects of physical capital accumulation. The latter variables control the effects of macroeconomic policy. The openness is presumed to affect the growth positively, while high inflation adversely affects the growth.

Within eleven years, the data used for the analysis comprised a panel of 36 countries over the period 1999-2012. The fiscal variables are from the IMF's Government Finance Statistics. The general government final consumption expenditure is obtained from the World Bank's World Development Indicators (WDI) 2007.

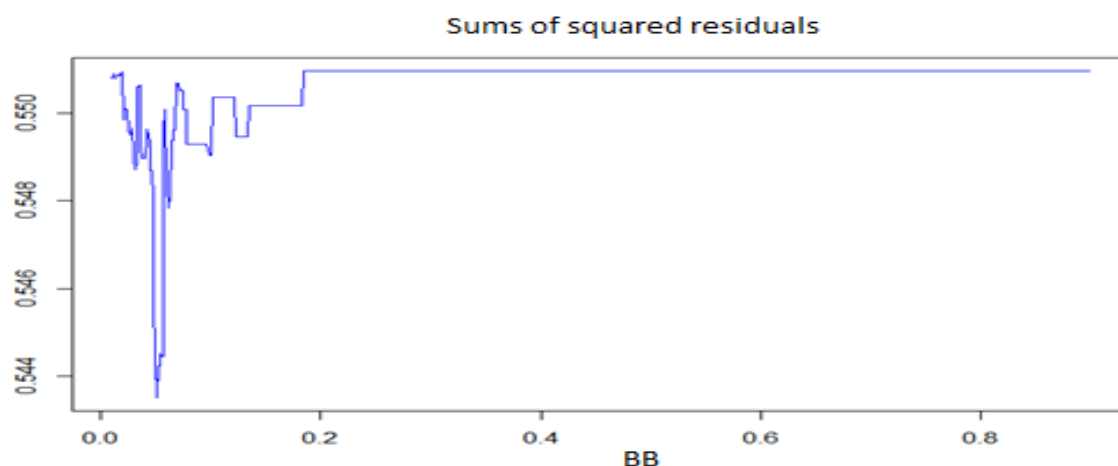
The table 1 in appendix A provides summary statistics for the data and defines the economic variables used in the paper. Our panel is built with annual data as Ary Tanimoune, Combes and Planes (2005). The fact of not using the average of five years may cause a potential problem endogeneity due to a simultaneous response of savings and investment that deal with endogenous reactions of the government to overall growth rate. This masks a wide disparity across countries and cross times. The matrix of correlation coefficient indicates that all variables have a significant correlation coefficient with the dependent variable.

#### **IV-Results:**

The estimation of the previous model requires first: the determination of the endogenous optimal threshold of the fiscal deficit, for which the activity in the sample switches from one regime to another. Indeed, this threshold was determined by the design of a program running on the software R<sup>11</sup>.

The test's results confirmed the existence of a nonlinear relationship between the economic growth and fiscal deficit. In fact, it can be seen on the Graph 1 below in which we have the description of the fiscal deficit threshold that minimizes the sum of the squared residuals reaching about 5.1%<sup>12</sup>.

Graph 1: Evolution of sums of squared residuals based on the level of the fiscal deficit



Source: based on the results of the software R.

<sup>11</sup> : This program is attached.

<sup>12</sup> : Annex n 1 : introduced by maximum likelihood rate. This latter presents the non-rejection intervals determined threshold.

As showed above in the last graph, we can observe that the optimal threshold of the fiscal deficit is 5.1% above the fiscal deficit would have a negative impact on the economic growth and below which the impact would be positive<sup>13</sup>. It is clearly easy to notice that the nonlinear effects of the fiscal policy influence the economic growth. This threshold constitutes a crossing point from the Keynesian regime (regime 1) to the non-Keynesian one (regime2). The obtained threshold in our study is 5, 1% .Thus it is interestingly important to recall that the fiscal deficit within the Keynesianism regime has sing the economic growth while the same fiscal deficit within the anti-Keynesian regime has a recessionary effects on the economic growth.

Table n° 2: The percentage of countries according to the optimal threshold (5.1%) which is presented by both regimes and years.

Years							
	1999	2000	2001	2002	2003	2004	2005
Regime 1(keynesian)	11	13	11	11	13	5	13
Regime 2 (anti-keynesian)	89	87	89	89	87	95	87
Years							
	2006	2007	2008	2009	2010	2011	2012
Regime 1	5	11	13	11	11	13	5
Regime 2	95	89	87	89	89	87	95

After the analysis of this table, we can observe that the percentage of countries belonging to the second regime (Anti-Keynesian) remains high throughout the period of this study.

The percentage of countries which belong to the first regime (Keynesian) varies between 5% and 13%, whilst the percentage of countries which belong to the 2nd regime varies between 87% and 95%.

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<sup>13</sup> : To test the existence of more than one threshold, we estimated the equation through the last square method, taking into account the sequential way presented as follows: 0.1 and 2 thresholds. Because of the small sample, we made use only of two thresholds maximum. Based on statistics F1 and F2, the only hypothesis that was not rejected was the presence of 1 threshold (see Annex 2).

Table 3: the estimated fiscal deficit impact on the economic growth.

Dependant variable: CE "the economic growth"				
threshold (5,1%)				
	Estimate	Std. error	t value	Pr(> t )
(Intercept)	-0.0002557	0.0014835	-0.172	0.863230
EPG	-0.0837141	0.0553565	-1.512	0.131103
INF	-0.0473314	0.0392626	-1.206	0.228582
SB	0.1399177***	0.0502729	2.783	0.005589
GD	-0.0210652***	0.0092638	-2.274	0.023398
CC	0.1084393**	0.0644256	1.683	0.092973
DCA	-0.2027272***	0.0734374	-2.761	0.005985
INVinf (5,1%)	0.2119661***	0.0623662	3.399	0.000732
INVsup (5,1%)	-0.1219280	0.1393284	-0.875	0.381937
Test of Wald H0 : $\delta = \theta$ F(8,495)=8.154				
P-value= 0,0000				
P-value	2.218e-10			

The t-statistics are retained for significance: \*\*\* (5%); \*\* (10%)

The linearity test led to the rejection of the null hypothesis. In other words, the p-value of the Wald' statistic is less than the different thresholds for significance (5% and 10%). We can conclude that the relationship between the fiscal deficit and economic growth is not linear for the recent, studied sample.

Based on the table above, we can notice that the coefficient of the variable INVinf (5.1%) is positive. To illustrate, if the fiscal deficit is below the rate of 5.1% of the GDP, then the total of the investment will have a positive effect on the dependent variable EG. In contrast, the coefficient of the variable INVsup (5.1%) is negative, which means that if the fiscal deficit exceeds the value 5.1%, the investment will have a negative effect on EG.

In addition, four variables had a significant impact on the economic growth. Both the global debt (GD) and final spending on government final consumption (SGS) had a negative impact on the dependent variable, while the other two variables namely the FB and CC had a positive impact on the so-called variable.

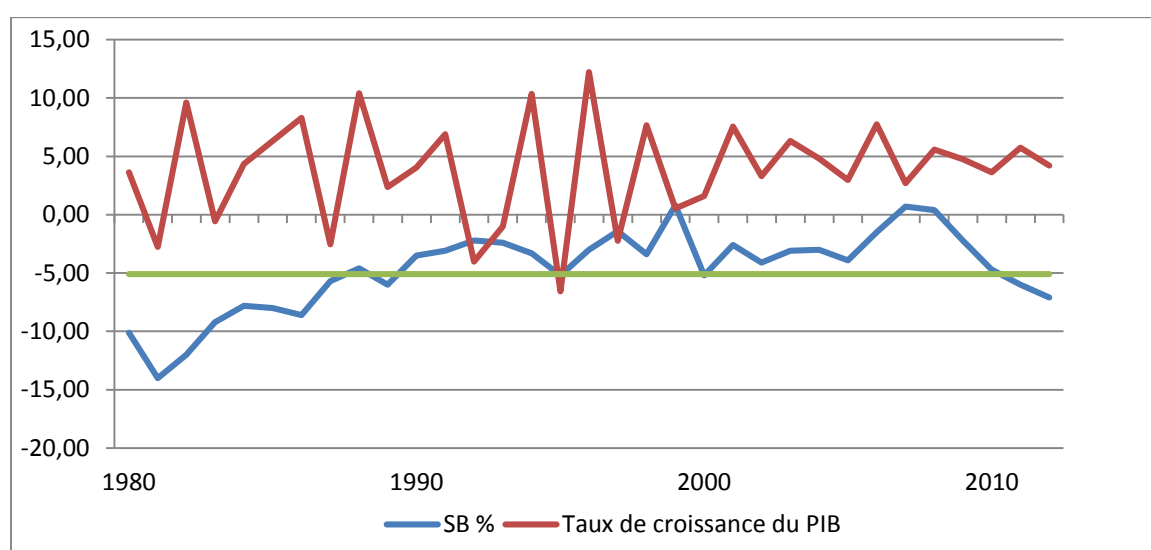
The increase in public debt and government's final consumption affects negatively the economic growth. The countries presented within the examined sample must then reduce their final consumption expenditure of the government in favor of the productive investment taking into consideration the obtained fiscal deficit threshold.

Based on the characteristics of the countries studied above, it should be noted that the fiscal deficit for some countries does not exceed 5.1%, which means that whatever fiscal policy that may generate a deficit will definitely have a positive impact on the economic growth as soon as the level of the deficit remains below the 5.1% threshold. So we can easily observe that the margin's maneuver for some countries is so crucial to regain the shortfall.

### **Threshold effects analysis in Morocco:**

To strongly apply the results obtained in the previous sections, we did use the dropping of this result specifically on Moroccan data namely two variables: the fiscal deficit and the annual growth rate of GDP. Both of these series covered the period from 1980 to 2012<sup>14</sup>.

Figure n°2: The evolution of the economic growth and the fiscal deficit compared to the threshold obtained:



Data Source: the fiscal deficit is obtained from HCP while GDP is obtained from World Bank.

Reading the above graph shows that during the first decade, the deficit threshold was highly respected only in 1988 (4.6%), also we have noted that the first three years<sup>15</sup> of this decade showed a higher deficit rate during the period of the study (10%, 14% and 12%). This period marked a turning point in economic, cyclical and structural policy in Morocco. Basically, this period was dominated by the necessary macroeconomic stabilization and fiscal consolidation research through the Structural Adjustment Program (SAP). This latter adopted in 1983 in order to restore macroeconomic stability, reduces the external debt and free the market forces<sup>16</sup>.

<sup>14</sup> : The objective is to fully describe the evolution of these variables by supplying the obtained threshold. Note that in the period of the determination of the 1999 to 2012's threshold; we hypothesize that the determined threshold is valid before 1999. This choice is justified only to integrate the two decades (1980 and 1990) which experienced notable events for the Moroccan economy.

<sup>15</sup> : Period before applying the structural adjustment program (SAP) in Morocco.

<sup>16</sup> : the SAP were adopted with the support of the IMF and the World Bank, the stabilization program is essentially based on reducing the financial commitment of the state, control of domestic demand and mobilization of local savings.



The 90s decade marked a return to respect this threshold except for the following two years (1995.2000); hence, there is a slight overshoot of this threshold (5.2%). This public financial recovery policy had reduced the fiscal deficit from 9.2% of GDP in 1983 to 2.2% in 1992. The Investments spending was the reason behind some severe cuts as: the share of investments in total budgetary expenditures was divided into three during this decade. In addition, the structure of the financing of fiscal deficit had profoundly changed. Instead of foreign loans, the government did use the internal sources of funding that are largely predominant since the implementation of the SAP<sup>17</sup>.

The 2000 decade was marked by a recurrent fiscal deficit; the state relied in particular on the privatization receipts and gains on debt rescheduling. The sale of state's assets contributed greatly to the reduction of fiscal deficit. Thus, through these windfall revenues, the fiscal deficit fell to 3.1% of GDP on average over the 1996-2003 periods; therefore, in 2003, the deficit was set at 2.6% thanks to the sale of 35% of Morocco Telecom to Vivendi which bailed out the state's coffers.

During the last decade, there had been a reduction in the fiscal deficit from 3.4% of GDP between 2001 and 2005 to 1.5% of GDP on average over the period 2006-2010, in addition to the realization of surplus in 2007 and 2008 (0.6% and 0.4% of GDP respectively).

In 2010, the fiscal deficit stood at 35.8 billion dirhams about 4.7% of GDP after 15.9 billion dirhams approximately 2.2% of GDP a year earlier, taking in account the increase in the stock of arrears of 6.9 billion dirhams compared to the end of December 2009. The state's treasury needed a net borrowing of 28.9 billion dirhams against a need of 18.5 billion dirhams a year earlier.

The rest of this decade proved a remarkable respect to this threshold. However, the last two years of the period of study showed a threshold that exceeded respectively for 2011 and 2012 (6%, 7.1%).

The table below shows the position of Morocco in both regimes studied including the behavior of the economic growth in relation to the obtained threshold.

**Table 4: Morocco's position in both regimes studied according to the Growth of GDP:**

	N. observation	Average	Median	Standard deviation
Regime 1(keynesian)	20	0,0471	0,0478	0,0423
Regime 2(anti-keynesian)	13	0,0259	0,0364	0,0468

We can notice that during the period of study, Morocco adhered to the first regime 20 times against 13 times for the 2nd regime. Generally the situation of Moroccan public finance in the 80s led the country to a position in the 2nd regime where the fiscal deficit was a structural data of public finances. It reached (14%) in 1981 which led to the adoption of the SAP to consolidate

<sup>17</sup> : Inspired by the fiftieth Anniversary Report « 50 de développement humain, perspectives 2025 ».

public finances. The fiscal consolidation policy has helped Morocco to guarantee a position in the first regime (Keynesian) during the past two decades (1990, 2000), except for the following two years (1995, 2000) where the fiscal deficit reached the value of 5.2% for both years.

On the other hand, the public spending underwent some structural and economic pressures that led to the increase the burden of the compensation fund and weight of the payroll. Budget expenditures had an average annual increase of 10% between 2009 and 2012. This policy damaged the deterioration of the budget balance from a surplus of 0.4% of GDP in 2008 to 6% deficit in 2011 and 7.3% in 2012<sup>18</sup>. As a result, Morocco adhered to the second regime in the last two years.

Another very important observation drawn from reading the above table is that the passage of the first regime to the 2nd regime, meaning "when the fiscal deficit exceeds the threshold of 5.1%," leads to the lower average growth of 2.12%<sup>19</sup> and the median growth of 1.14%<sup>20</sup> which proves that the respect of the optimal threshold deficit improves the evolution of the economic growth.

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<sup>18</sup> : The rate of public debt reached 59.6% in 2012; it was close to 47.1% of GDP in 2009.

<sup>19</sup> : 2,12% is obtained from the difference between the average growth in the first regime and that of the 2nd regime (0,0471 – 0,0259 = 0,0212%).

<sup>20</sup> : 1,14% is obtained from the difference between the median growth regime 1 and that of the second regime. (0,0478 – 0,0364 = 0,0212%).

### **V-Conclusion:**

The purpose of this study is to evaluate the impact and the effectiveness of the fiscal policy on the economic growth; therefore, the methodology used to determinate the endogenous threshold of Hansen (1996, 1999, 2000) allows to find an optimal deficit threshold of 5.1% for the sample observed. In fact, from this threshold, the relationship between the fiscal deficit and economic growth is non-linear. Below this threshold, the Keynesian expansionary fiscal policy is effective, and above this latter becomes negative. In other words, this threshold represents the main point of change from the Keynesian to the anti-Keynesian regime.

The empirical results show that the global investment has a positive effect on the economic growth when the fiscal deficit is below 5.1% of the GDP; however, when this deficit exceeds this threshold, the global investment has a negative effect on the economic growth.

The increase of the public debt and the final consumption expenses of public institutions have a negative impact on the economic growth. Therefore, the countries concerned by the study should decrease these expenses in favor of the productive investment.

These conclusions give birth to many questions concerning the rules and fiscal disciplines established for the sample used in this study. For instance, in Morocco and according to last years' analysis in which the fiscal deficit changed in terms of the limits 6, 8% in 2011 and 7.4% in 2012, the government should have reduced this deficit in order not to exceed the threshold already fixed. Moreover, we should wonder whether we can really bear the public deficit with this threshold.

We can conclude from this analysis that the results should take into consideration the characteristics of the countries concerned by the study. In addition, the structural balance should be more privileged than the general one, because this latter reflects better the states discretionary policies.

This study can also improve methodologies by using other panel's models like: Panel Smooth Threshold Regression (PSTR<sup>21</sup>) and Panel Smooth Transition Autoregressive model (PSTAR<sup>22</sup>).

It would be possible to take the works of González and al as an example (2005), Minea and Villieu (2007) or Fok and al (2005). For the first ones, the transition between the different regimes can't be sharp but smooth. Concerning the estimation approach, it is relatively like the one used by Hansen, and for Fok and al (2005) who suggested an alternative model in order to authorize an autoregressive structure for the purpose of anticipating.

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<sup>21</sup> : See González et al. (2005) ou Minea et Villieu (2007).

<sup>22</sup> : See Fok et al. (2005).

However, it will be interesting in a future research to look for the impact of the fiscal policy on every country of the sample, taking into consideration the budgetary and financial characteristics. Will this impact be in Morocco? It will be also better to add other variables like replacing the dependent variable by the output gap which is the difference between actual GDP and potential GDP.

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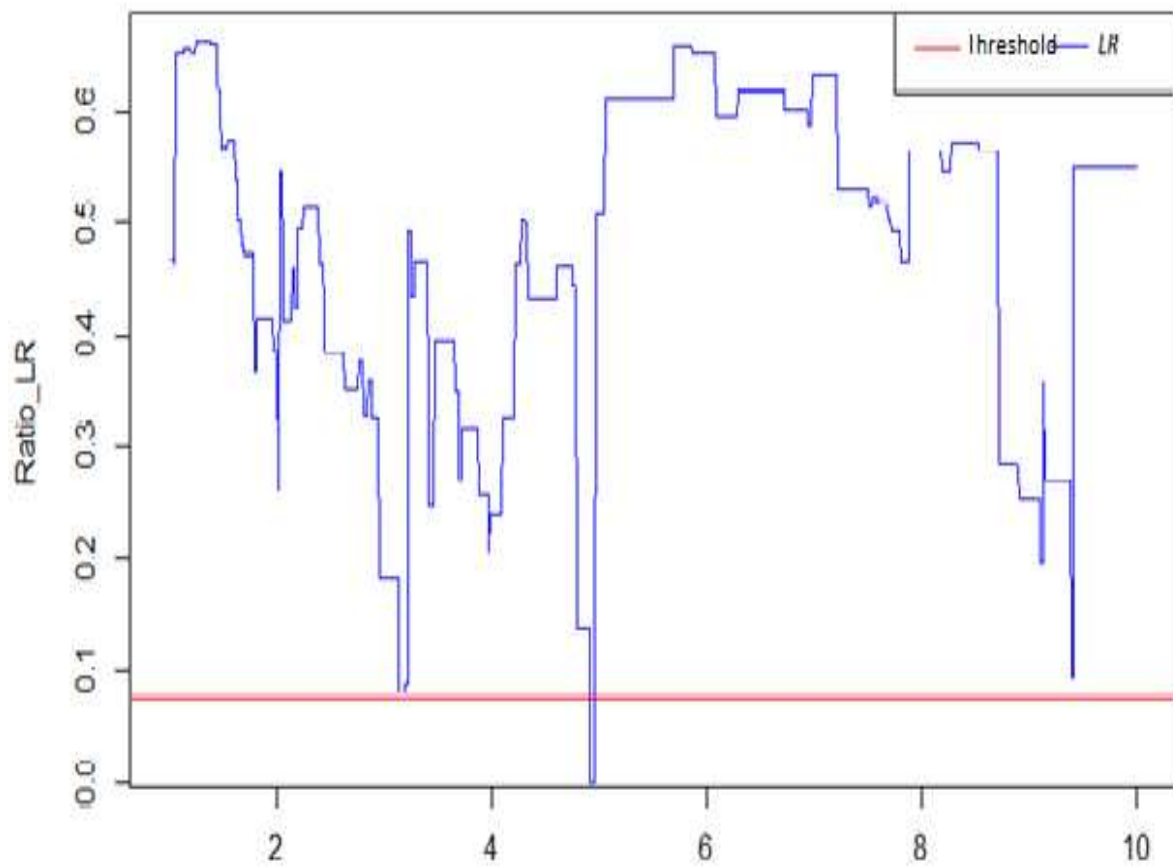
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## Annex 1: the non-rejection intervals of determined threshold



Source: based on the results of the software R.



## Annex 2: Statistical Inferences concerning the existence of the second threshold.

The procedure's determination of two endogenous thresholds  $(\gamma_1, \gamma_2)$  showed through the estimation of the equation follows:

$$EG_{it} = \alpha_i + \beta X + \delta INV_{it} * I(BB_{it} \leq \gamma) + \theta INV_{it} * I(BB_{it} > \gamma) + \varepsilon_{it}$$

Following Hansen (1999), the sum of squares of residuals  $S(\gamma_1, \gamma_2)$  is calculated and the values of two thresholds  $(\gamma_1, \gamma_2)$  are those that minimize  $S(\gamma_1, \gamma_2)$

Based on the sequential way of the thresholds, when F1 indicates that we cannot accept the  $H_0$  assumption of linearity then the F2 statistic used to assess the possibility of having more than one threshold. The F2 test had been done on the basis of the difference between the sums of squared residuals in order to test the existence of two thresholds. The significance likelihood ratio (Pvalue) F2 is calculated using the same method the first threshold, which will allow us to judge the statistical validity of the second threshold. In our case, the following table rejects the hypothesis of the second threshold.

<i>Test on the non-linearity with two endogenous thresholds</i>	
First endogenous threshold CC (method of Hansen) %	5.1
-----	
confidence interval of 5%	[4.5 - 6]
Second endogenous threshold CC (method of Hansen) %	10
-----	
confidence interval of 5%	[9 ,6 ; 12]
$H_0$	$\beta = \theta$
F2	5.333333
p-value (simulation)	
Valeur critique F2 à 5%	0.069
Nombre de simulations	2000